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A STUDY OF FOREST MANAGEMENT PRACTICES
ON THE FLATHEAD NATIONAL FOREST, MONTANA

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A STUDY OF FOREST MANAGEMENT PRACTICES ON THE FLATHEAD NATIONAL FOREST, MONTANA

by

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for

KALISPELL CHAMBER OF COMMERCE
KALISPELL, MONTANA

October 1972

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PREFACE

In May of 1972 I was asked by the Western Forest Industries Association to organize a study of forest management practices on the Flathead National Forest specifically for the Chamber of Commerce of Kalispell, Montana. The Chamber, representing a wide spectrum of interests in the Flathead Valley including forest industry, recreation, and conservation groups as well as local business, was deeply concerned about the reduction in allowable cut proposed by the Flathead National Forest. It was concerned also about the increasing conflicts and polarization among the various groups of national forest users.

The problems and conflicts surrounding the management of the Flathead National Forest are typical of those of many other of our national forests. It was felt that solutions found here would be valuable both locally and nationally. The study was undertaken under the following conditions:

1. The initiation of the study was to have the full concurrence of the U. S. Forest Service.
2. The study would embrace all the forest management practices, not just the allowable cut issue.
3. The study team would consist of an interdisciplinary group of experts from western United States and the chairman would be given full authorization to select such a team.
4. The study team would report to a Chamber of Commerce citizens' committee representing a variety of management concerns.

These conditions were all fulfilled. The study team selected consisted of:

Dr. George W. Brown, Associate Professor of Forest Hydrology, School of Forestry, Oregon State University (forest hydrology, water quality, forest ecology).

Mr. Don L. Brown, Director, Department of Fish and Game, State of Montana, Helena, Montana (wildlife biology and ecology, natural resources administration).

Dr. Lawrence S. Davis, Head, Department of Forest Science, College of Natural Resources, Utah State University, Logan, Utah (natural resources economics, forest administration and management).

Dr. Stanley P. Gessel, Associate Dean, College of Forest Resources, University of Washington, Seattle, Washington (forest soils, forest ecology).

Dr. William J. McMannis, Professor of Geology (and Certified Professional Geologist), Department of Earth Sciences, College of Letters and Science, Montana State University, Bozeman, Montana (geology).

Dr. David Wooldridge, Associate Professor of Forestry, College of Forest Resources, University of Washington, Seattle, Washington (watershed management, forest soils).

Dr. Robert E. Dils, Dean, College of Forestry and Natural Resources, Colorado State University, Fort Collins, Colorado (forestry and natural resources administration and management), Chairman.

We feel the report presented here is objective and unbiased and we accept full responsibility for its content. We sincerely hope the recommendations contained in the report will provide some guides to the management problems of the Flathead National Forest. We feel also that many of the recommendations have application to the management of our forest lands throughout the United States.

Robert E. Dils
Fort Collins, Colorado
October 1972

ACKNOWLEDGMENTS

The Study Team extends its deep appreciation to all those who have contributed to this report. First and foremost, it would have been impractical to undertake this study project without the full cooperation of Supervisor Ed Corpe and the entire staff of the Flathead National Forest. We fully recognize the time and effort involved in their preparations for and participation in our visits to the Flathead Forest.

While it is impractical to note all our acknowledgments we do especially wish to express appreciation to Mr. Steve Yurich and his staff from the Regional Office of the U. S. Forest Service in Missoula; to the Forest Land Resources Committee of the Kalispell Chamber of Commerce, chaired by Mr. Harold McLaughlin; to the Flathead National Forest Citizens Advisory Council; to the County Commissioners of Flathead County, and to the area industries visited.

A special acknowledgment is made to the Montana Department of Fish and Game for making its Director, Don L. Brown, available as a member of the Study Team. We recognize also the contribution of Dr. Carl Newport of Mason, Bruce and Girard (Consulting Foresters, Portland, Oregon) in the computer analyses and reviews connected with this report.

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THE FLATHEAD FOREST: PHYSICAL CONSIDERATIONS

A brief description of some of the physical features of the Flathead Forest area is provided as background for both some of the assessments and the recommendations made in this report. Climate, soils, geology and hydrologic factors were given particular attention during the study.

1. Climate.

The climate of the Flathead National Forest area is intermediate between the maritime climate of the Pacific Northwest and the continental climate of the interior Great Plains.

Kalispell has essentially a continental precipitation distribution spread fairly evenly throughout the year. Maximum precipitation occurs in May and June (approximately two inches each month). Average annual precipitation is 15.02 inches. Orographic increases in precipitation may account for as much as five times this amount in the neighboring high mountains.

Average precipitation at Hungry Horse Dam is 32 inches. Although maximums occur in mid-winter (November through January average is about 3.5 inches/month) Hungry Horse also has the precipitation characteristics of a continental climate with 2.5 and 3 inches occurring in May and June.

Marked variations in rain storms may occur due to the influence of the Continental Divide and convectional storms which will hit eastern portions of the Forest but not the lower valleys or western portions of the Forest.

Marked imbalances in year to year precipitation may occur throughout the Forest. Once every ten years annual precipitation in Kalispell should be less than 12 inches, and once every twenty years, precipitation should exceed 20 inches. Largest percentage increases in precipitation occur as rainfall in the summer growing season.

Convectional storms are relatively rare in spite of a combination of topographic and atmospheric conditions which suggest their frequent occurrence. Rainfall rates seldom exceed two inches per hour.

With low minimum temperatures, precipitation between October and April usually occurs as snow. The influence of the maritime climate, however, allows for rainfall any month of the year with temperatures frequently above 50^{o} in Kalispell, even during winter months. All major floods of record in the Clark Fork system resulted from rainfall on snow during the melt season.

Average minimum temperatures are below freezing from November through March. Average maximum temperatures are below freezing in December and January. The anticipated growing season is 150 days near Kalispell. The figure is markedly lower in the surrounding mountains. At higher elevations average maximum temperatures in the forest zone seldom exceed 70^{o} and freezing temperatures may occur any month of the year.

II. Soils

Forest soils of the Flathead National Forest can be broadly classed into zonal soils of the brown podzolic and gray-wooded great soil groups. Few intrazonal soils are forested and azonal soils are largely regosol or alluvium. Tills, moraines, or alluvia have resulted from the massive glaciation and related river flows. The soil types are closely related to land form and physiography.

The brown podzolic soils include the Krause, McCaffrey, Selle, and Waits series. These soils series occur on nearly level to relatively steep relief. Under normal conditions infiltration rates will always be greatly in excess

of expected precipitation or snow melt rates. Parent materials for these soils were gray, green and reddish argillite, quartzite, and dolomitic limestones from the Belt geologic formation.

Gray-wooded soils have also developed under coniferous forests on parent materials of alluvial and glacial origin. They also embrace a wide range of relief from nearly level to very steep. Most are excessively to moderately drained with very high infiltration and percolation rates. The Stryker series is an imperfectly drained alluvium of limited occurrence.

The Whitefish series is a gray-wooded soil occurring on well drained, light colored, silty materials of calcareous origin. These soils occur extensively in the Tally Lake area. The glacial parent material contains a high percentage of large stones derived from the Belt formation.

The distinction between the Waits series and Whitefish is largely based on the occurrence of light colored, silty materials in the Whitefish and on a much higher percentage of angular rocks and fragments in the Waits. The Waits also includes many coarser materials derived from quartzite.

With the exception of those which are imperfectly drained, the zonal soil groups which occur on much of the general forest zone do not appear to present major forest management problems.

Soils of the high elevation zone may be classed largely as regosols or immature colluvial materials. Little soil development is exhibited on these areas with high amounts of bare rock and talus. The marginal forest zone might contain a few soils which exhibit initial processes of soil formation. However, these would also be classed largely as regosols and colluvial materials. The previous discussion of zonal soils applies also to the general forest zone.

III. Geology

The dominant geologic influence was the continental glaciation of the Pleistocene era. The Rocky Mountain Trench extending from British Columbia south through the Flathead Valley was filled with a massive glacier. The valley floor was left with a thick covering of glacial material. Valley walls show the combined effects of continental glaciation with mountain glaciation. The extent of continental glaciation on major ranges may be identified by the thickness of forest cover and occurrence of non-vegetated areas. Relatively thick mantles of moraine and debris occur throughout the general forest zone. Elevations above this zone are steep with very thin mantles of moraine and debris.

Bedrock in the majority of the area encompassed by the Flathead National Forest is made up of various formations of what is termed the Belt Supergroup. These formations are fine grained carbonates, argillites (hard, silicic clay-rich rocks), siltites (silicified siltstones), and quartzites (silicified sandstones). In general the clay fraction of the rocks is comprised of illite-chlorite-sericite, and this fraction decreases from the argillites (as much as 45%) to siltites to quartzites (10-20%). This trend is also true of the feldspar content. The carbonates are generally impure dolomitic limestones, containing varying amounts of quartz, feldspar, and illite-chlorite-sericite. Iron, in amounts varying from 1% to 5%, is disseminated through the rock either in ferric, ferrous, or sulphide form, (reference: U. S. Geological Survey Bulletin 1312-0).

Layering in these rocks varies from thin to thick and is inclined at various angles from place to place. In much of the forest, inclination (dip) of the layers is gentle and the bedrock would normally be quite stable. In

places where dip is steep, exceeding 35 to 40 degrees, care should be exercised in road placement. The more thinly layered units (argillites, calcareous argillites) tend to be less stable than the more thickly layered ones.

On steep ridges and canyon walls all of these rocks tend to form talus which accumulates at or near the angle of repose. The more thinly layered the rock, the smaller and platier the talus fragments, and in general the lower the stability of the resulting talus. Most of this material is likely to occur in the marginal areas.

In a large part of the Flathead National Forest the bedrock is blanketed by variably thick glacial, fluvial, and lacustrine unconsolidated deposits. In the major valleys (i.e., Swan River, Flathead Lake area, North Fork of the Flathead River) these are very thick. In other places they form a veneer on bedrock. As observed in several ranger districts these materials are surprisingly stable--apparently because the vast majority are quite permeable and drain rather readily.

A thorough knowledge of the distribution and type of surficial materials in the forest would be of great value to the U.S.F.S. in planning road or other construction, and in decisions pertaining to harvesting methods. Unfortunately, the detailed kind of information needed is not now available for most of the area. The geologist recently added to the Flathead staff could be used to advantage in starting on this problem in critical areas.

IV. Hydrology

While hydrologic data for the Flathead area are relatively meager, hydrologic behavior can be characterized for parts of the Forest. Annual hydrographs for representative discharges of streams have been published by the U. S. Geologic Survey (Simons and Rorabaugh 1971)

The South Fork of the Flathead prior to construction of Hungry Horse Dam provides one example. Average daily stream flows are lowest between September and February. Increases start with increasing temperature and day length through March and April reaching maximums in late May. Recession flows are generally steady returning to minimums in eary autumn. September records average minimum flows of 667 cfs while an average maximum of 12773 cfs occurs in May.

For the South Fork of the Flathead the maximum recorded discharge prior to impoundment by Hungry Horse Dam was 43,400 cfs (1948) and the minimum 206 cfs (1935). These values give a maximum/minimum ratio of 210 indicative of a relatively stable watershed condition (an equivalent ratio for the Methow River draining the east slope of the Washington Cascades is over 2000).

Similar stability is noted on smaller streams such as Emery Creek (approximately 26.4 square miles of drainage area) near Hungry Horse where the maximum recorded stage is less than three feet higher than the minimum stage.

Major watersheds appear to have the ability to integrate upstream hydrologic events. Maximum water yields even for major storms seldom exceed 40 cubic feet per second per square mile ($cfsm^2$). However, small upstream contributing watersheds have recorded highs of 450 cfsm (Simons and Rorabaugh 1964).

Instantaneous maximum flows on tributaries draining the Flathead Forest follow the usual pattern of flood peaking of the Columbia River system. Analysis of discharge of the Flathead River at Polson between 1908 and 1950 reveals 25 years of flood peaks either in May or the first week in June. Nine peaks have occurred in the second week of June and nine peaks after the second week of June. Upstream major tributaries follow a similar pattern.

The South Fork of the Flathead River gauged upstream from Columbia Falls peaked 30 times either in the first week of June or prior to that date. It peaked 6 times in the second week of June and only 3 times after the middle of June between 1911 and 1951. The Flathead River at Columbia Falls shows a similar pattern. It has peaked 23 times either in the first week of June or prior to that date. It has peaked twice in each of the second, third, and fourth weeks of June. Smaller contributing tributaries to these drainages have a less reliable period of record but also demonstrate similar patterns.

Between 1922 and 1957, the Swan River has peaked 4 times after June 15. The Stillwater River has only peaked once in June (6/3/33) in over 20 years of record. Logan Creek, which drains a substantial portion of the Tally Lake District, has never peaked as late as June and frequently peaks in April.

Organization of these data suggests that later flood peaks have their source in high elevation snow packs. Drainages with a lesser percentage of the watershed area in high elevations will have earlier instantaneous flood peaks.

Detailed study of all available hydrologic data leads to the conclusion that peak flows are related more to the dynamics of natural meteorological events than to any other factor or factors.

The physical hydrology of flood peaks correlates well with maximum instantaneous yields. Again, drainages of the Flathead Forest follow typical patterns for snow hydrology of the Columbia River system. Maximum instantaneous yields on a unit land area basis average 20 to 30 (cfsm) from drainages which have high elevation snow packs. Drainages such as Stillwater River, Logan Creek, and Swan River have maximums of 10 to 12 cfsm, minimums of less than one and averages of about 5 cfsm.

All major floods in western Montana are associated with seasonally heavy rain storms. Heavy storms occur near the Continental Divide during late May and early June and have been definitely associated with floods of 1894, 1906, 1916, 1927, 1938, 1948, 1953, and 1964. Climatic history has demonstrated an annual rainy season from about May 20 to June 30. During this 40-day period, atmospheric conditions prevail that are likely to produce general rains through central and western Montana. Air masses from the Gulf of Mexico may carry large quantities of water through the Plains states to Montana. This meteorological pattern developed to produce the floods of June 1964 (U.S.G.S. Water Supply Paper 40-B). Rainfall during the 36-hour storm period was as much as 14 inches on watersheds where streams were already high from a delayed snow melt runoff. Peak discharges ranged from 2 to 11 times the probable 50-year flood.

The Flathead National Forest, like most mountainous regions, contains a variety of topographic, climatic and soils conditions which produce a wide range of hydrologic situations. Within this diverse environment, however, two major hydrologic regimes stand out. West of a line generally running northwest along the crests of the Swan and Whitefish Ranges, total annual runoff and the magnitude of the annual floods are relatively low. Bodhaine and Thomas (1964), for example, note that west of this line the average annual runoff (5-20 inches) is about one-half to one-fourth of that east (30-60 inches) of the line (Figure 1). The authors also provide a geographic factor for calculation of the mean annual flood (Figure 2). West of this line, the multiplier is only one-half (0.73) of the east side value (1.43). This means that for the same levels of precipitation, equal drainage area, average annual runoff, and area in lakes, those areas to the west of this line should produce mean annual floods one-half the size of those to the east.

THE FLATHEAD FOREST: THE CURRENT SITUATION

The Flathead National Forest is representative of the climate of conflict current in public forest land management throughout much of the United States.

The Forest is ranked as one of the top timber-producing forests of the northern, central and southern Rocky Mountain regions. As a consequence it has supported a high level of development of forest industry. This industry development has contributed materially to both local and state economy and to the continually increasing national demand for wood. Local government is highly dependent upon income derived from national forest timber sales. Forest Service policies in the past have tended to be supportive of local industries and the local economy. Changes in land use decisions, particularly those which would adversely affect the local economy, are of serious concern to the residents of the Flathead Valley.

In response to the public demand for wood and wood products the forest industry in concert with the U. S. Forest Service has increased its capacity to harvest and process timber. State agencies and private forest land owners have also followed this trend. Industry expansion was based in large part upon anticipated annual cuts established in earlier Forest Service management plans.

Forest Service efforts to provide timber to meet the allowable cut for the Flathead Forest have resulted in ever-increasing road systems into formerly roadless back country. Lack of basic information and the pursuit of economic efficiency has sometimes led to ecologically inappropriate location

of these roads. Some areas have been harvested that probably should not have been, at least not in the manner in which the harvest was actually conducted. Some of the timber harvesting operations were poorly planned, supervised and executed - at least by 1972 standards. Fortunately, however, reproduction and recovery of such areas has generally been rapid and excellent.

In addition to its high timber producing capability the Flathead Forest has unusual scenic and recreational attractions and values. Approximately one third of the forest is already set aside as wilderness. It is adjacent to Glacier National Park. It is endowed with an abundance of lakes and streams, magnificent mountains and fish and wildlife resources. It is also one of the last strongholds of the grizzly bear and west slope cutthroat trout.

Many local,state and national interests are deeply concerned that these resources and values will be degraded and despoiled. Overall ecology as it is affected by clearcutting, road systems and aesthetic deterioration has been the primary concern of the majority of those objecting to past timber harvest practices.

An ever-growing segment of the American people seems to be increasingly aware of public land management decisions that are, in their opinion, in conflict with their way of life or their values. These conflicts will always be a thorn in the side of land resource managers. With the inevitable wide diversity of these interests, compromises seldom satisfy anyone. Years ago when survival in the Flathead was a major task in itself, very few people were concerned with the scenic beauty and recreational opportunities of these forested lands. That has now changed drastically both legally and from the standpoint of public desires in the management of such land.

The Multiple Use-Sustained Yield Act of 1960, the Wilderness Act of 1964, and the National Environmental Policy Act of 1969 as well as recent legal decisions dictate that we must include all values before making management decisions. These various existing laws controlling land management decisions are often seemingly in conflict, in interpretation if not in fact. Where the Multiple Use-Sustained Yield Act apparently made choices competitive and demanded consideration of economic values, the National Environmental Policy Act clearly says that other values, including non-use are competitive values which may be of greater importance to society.

The Forest Service has long been an advocate of the multiple use of forest land. Their failure to achieve all that they themselves have wished in the broad application of this concept to our public forest lands, however, must be shared by the entire United States. The Forest Service has long been denied by Congress the funds necessary for such application, particularly for the non-timber uses of the forest. Only within the past five years has the public in general voiced a strong interest in multiple use and in the preservation and improvement of the quality of the environment, including the forest environment. The Forest Service is responding to this public interest with a program directed to maintaining and improving environmental quality. Nevertheless the climate for decision making in the Forest Service has grown increasingly harsh and it is expected to remain so. The best judgment of the public resource manager is always subject to the influences of his immediate environment and his decisions will never make everyone happy. Similarly, this report cannot hope to please each of the groups concerned with each of the points involved. Nor is it meant to make decisions for the public resource manager. It can evaluate the past situation as impartially as possible, it can suggest approaches and methods for arriving at decisions. This it attempts to do.

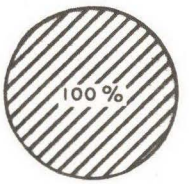
The major management changes under consideration for the Flathead National Forest were described in a document dated April 12, 1972 titled "Facts Concerning an Option for Revising the Annual Allowable Cut." Pages 3 and 4 of this document summarize these proposed changes and are reproduced below.

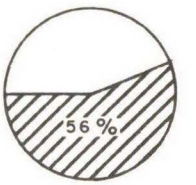
April 12, 1972

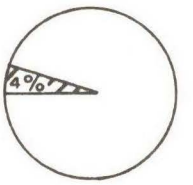
FLATHEAD NATIONAL FOREST

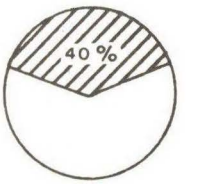
LAND CAPABILITY/USE/ALLOCATION

Total Acres NF Land:	2,355,366	
Lands Not Considered in Timber Growing Land Base	1,316,751 acres	
Includes	334,665 acres	(1) High Area Zone
	709,442 acres	Bob Marshall Wilderness
	75,361 acres	Mission Mt. Primitive Area
	15,349 acres	Jewel Basin Hiking Area
	181,934 acres	Non-Forested (water, roads, etc.)
(2) Deferred (Middle Fork & Wild Rivers)	96,276 acres	
Land Considered in Timber Growing Land Base	942,339 acres	
Includes	203,780 acres	(3) Marginal
	46,240 acres	(4) Special Zones (TIZ/WIZ primarily)
		(5) Standard (mostly GF zone)









DEFINITIONS

(1) STANDARD: Land areas where timber can be harvested using today's methods and equipment with adequate consideration to other resource values.

(2) SPECIAL: Land area where timber harvesting requires special consideration for scenic and recreational objectives. This is the water and travel influence zone.

(3) MARGINAL: Land areas where timber management requires special methods and equipment to avoid damage to other resources. Generally below the high area zone.

(4) HIGH AREA: Land areas of subalpine and alpine vegetation types. These are thin soil areas where trees are usually un-merchantable, slow growing, and difficult to regenerate. Areas have high scenic values.

(5) DEFERRED: Land areas under study to determine land management objectives where there is a possibility that timber harvest may be prohibited.

FLATHEAD NATIONAL FOREST

April 12, 1972

Revision of AAC (Annual Allowable Cut) based on one series of calculations.

	1969 Timber Management Plan	1972 RAM (Resource Allocation Method)
Total AAC	194.6 MMBF (million board feet)	175.8 MMBF (million board feet)
Middle Fork 1970 moratorium	13 MMBF	
Middle Fork plus Wild Rivers deferred volume		16 MMBF
AAC available	181.6 MMBF	159.8 MMBF
Volume included above from marginal areas (will require modified logging techniques)	unrecognized	31.2 MMBF
AAC with conventional logging techniques	181.6 MMBF	128.6 MMBF
Type of cutting required to realize above totals:		
Regeneration cut (Shelterwood, seed tree clear-cut or selection)	157 MMBF (13,742 acres)	96.3 MMBF (8,833 acres)
Overstory removal	16.6 MMBF	12.0 MMBF
Commercial thinning	4.0 MMBF	6.9 MMBF
Salvage	4.0 MMBF	4.0 MMBF
Utilization of 7" - 9" logs	0	9.4 MMBF
Available Total AAC	181.6 MMBF	128.6 MMBF

ASSESSMENTS

Land Management Planning

The present proposed change in allowable cut is an interim decision resulting from a change in forest planning methods. Because of this, immediate examination of a change in allowable cut or, for that matter, any other specific decision would be out of context. First, the planning method must be evaluated. If the method proves sound, then the specific decisions, such as a change in the allowable cut, must be evaluated as to their consistency with the planning and decision framework from which they arose.

It will be difficult either to sharply criticize or to praise any particular decision since this is a time of transition, and it will be more than a decade before the new planning methodology is fully implemented. Of necessity, most present decisions will be based on partial information and will be made by public land managers who are themselves in a process of learning and adapting to a new way of dealing with their responsibilities. Decisions can be expected to be conservative where the possibility of irreversible damage exists.

The New Planning Method

The terms "old" and "new" will be used only as a means of contrasting planning methods. The "old" or traditional method might best be characterized as functional and usually "from the top down." Quantitative resource information on timber, range, wildlife, etc., was typically collected through a variety of surveys to give a description of the forest as a whole. Plans were

independently made for each resource at the forest level (for example, the "Timber Management Plan" or the "Wildlife Plan") and then allocated for implementation to the ground on a quota basis. Adequate site-specific resource information was not generally available for these allocations and implementation decisions, and the personal expertise of the managers was heavily relied on.

In the late 1960's the various U.S. publics developed a much stronger sense of environmental awareness and considerably more sophistication about where the public lands were and how they were being managed. In general, the publics began demanding more services from the public lands, actively showed less tolerance for managerial mistakes which they judged to be degrading the resource, and wanted more say in decisions on usage of public lands.

The new planning method has evolved in response to this heightened public interest and is structured to improve performance in the following areas:

1. Increased awareness and sensitivity to resource capability and to ecological limitations on resource use.
2. Increased recognition of additional (non-timber) resource values such as aesthetics, fisheries, wildlife and recreation.
3. Increased public involvement in management planning and decision-making.
4. A clarification of the objectives of public land management.
5. Improved competence and public credibility of the managers.

The present planning and decision-making methods and procedures of the Flathead National Forest can be reviewed and evaluated relative to these five areas.

Resource Capability and Ecological Limitations

Perhaps the most profound change in planning has occurred here. The Forest has been subdivided into 35 planning units, and resource capability

is being systematically assessed from the ground up. For each unit, site-specific information is being collected on land forms, soil, hydrologic attributes, vegetation, etc. The information is then interpreted for the potentials and limitations of all management activities on each site. For example, in part of some particular planning unit the soil may be found too shallow or unstable to permit the construction of access roads. Other parts may be found to have high potential for timber production. Still another part may have high recreation potential, but the hydrology is such that self-contained sanitary facilities are required to avoid stream pollution.

Overall, this approach to resource assessment is the reverse of the old system in that information and planning is built from the bottom up rather than from the top down. The whole process can be viewed as a much more sophisticated method of establishing environmental constraints on management activity.

Of necessity, such planning is expensive and time consuming. Three levels of planning intensity have been defined for the Flathead with Level I being the most intensive. Level II planning is an interim stage utilizing additional data as it becomes available. Level III planning is a "once-over-lightly" based completely on existing maps, air photos, and other available information coupled with some ground reconnaissance. With present finances and manpower, it will be a decade or so before all planning units of the Forest receive the highest level of planning. Level I planning requires detailed new survey data, ground inspection by specialists, and an intensive team analysis and review of the findings. Until such planning is complete, most of the decisions over the next several years will have to

be founded on Level II and III planning efforts and will be justified more on the basis of judgment and experience than on hard quantitative data.

A complete description of Level I planning procedure is found in Working Draft II, Guidelines for Development of Unit Plans, Regional Office, Missoula, dated July 1972.

Based on our review of the Guidelines and having observed what is happening on the Forest, we find the new approach to be on solid conceptual and ecological grounds. Planning from the ground up based on site-specific information is inherently a more consistent process. Each piece of land will be thoroughly appraised for its use potential. When complete, environmental "mistakes" such as erosion, mass failure, stream pollution, and damage to rare and endangered species should be markedly reduced. The latter observation assumes a continued effort on the part of the Forest to recruit and utilize a truly interdisciplinary team to their planning and decision-making staff.

The Forest seems to be sensibly allocating its limited planning resources by covering all units quickly with a Level III effort and then building up to Levels II and I on a priority basis.

The principal problem we see with this planning approach is the difficult necessity of coordinating the results of independent planning on 35 units into one comprehensive Forest plan. Will the total Forest plan simply be the sum of the 35 unit plans or are there Forest level priorities and needs which will require adjustment of the unit plans? The Forest is the administrative and politically identified planning unit for production. Therefore some specific procedure will be needed for adjusting and coordinating

the management of the many separate units into a Forest plan. Neither the Guides nor any of the written material we've reviewed addresses this issue. More will be said on this matter under the discussion on objectives.

Recognition of Non-Timber Values

The Flathead staff shows considerable awareness of non-timber values. In the Basic Land Management Plan, Part I sets forth the basic assumptions and needs of management. Sixteen of the 17 basic assumptions regarding resources and use deal with the expected rise in non-timber use: visual aesthetic quality, recreational diversity, and water quality are particularly stressed. Under the sections on coordinating requirements these uses are again stressed, and the management directions set forth generally urge caution and conservatism so as not to damage or endanger any of the non-timber values.

Actions on the Forest appear to back up these written guides and philosophy. Visual aesthetic quality now dominates design and location of roads and timber sales. Key wildlife areas and fish spawning streams are given first consideration. Today indications are that management would probably not hesitate to close a sale or stop construction of a road if they thought there was a possibility of damage to the site. Five or six of the present timber sales under contract have been recently revised and re-negotiated to reduce volumes cut or to change the specified logging practices--primarily in order to improve visual quality and to protect water quality.

In action, most of the Forest's budget and manpower is still expended on timber production, and the non-timber values are being treated as constraints

on timber activities. Non-timber activities should receive positive consideration through increased and direct allocation of funds.

Public Involvement

The Flathead Forest personnel are becoming increasingly aware of public opinion. The staff expends both time and effort attending meetings, verbalizing ideas, and paying attention to public reactions. Most importantly, the public is being involved prior to decision making. The Forest staff has used "listening sessions" as one formalized device for public involvement. The planning guide specifies that the public be involved in formulating and considering alternative management programs for the planning units. These listening sessions have clearly indicated a public concern for environmental quality and non-timber values.

Clarification of Objectives

Throughout the Forest Service recently a great deal of attention has been given to re-defining and clarifying the role of that agency in the United States. The Chief's statement of February 1970 entitled "Framework for the Future--Forest Service Objectives and Policy Guides", is the most recent formal statement at the national level. It lists eleven objectives without specifying priorities.

The first objective states, "Promote and achieve a pattern of natural resource uses that best meets the needs of people now and in the future." The second objective states, "Protect and improve the quality of air, water, soil, and natural beauty."

These two are the principal guides for on the ground management. The Northern Region has taken the Chief's objectives and added further

detail in a written statement entitled "Management Direction for the Northern Region, March 1972." This document briefly reviews the resource and use situation of the Northern Region and lists nineteen basic assumptions. Most of these assumptions acknowledge the growing demand for all goods and services from the forests and the increasing conflicts between different resources uses. Assumption #8 summarizes by saying, "Land management decisions will increase in complexity due to the need to harmonize social and economic needs with the ecological constraints to land and resource management activities."

The Regional Directions provide considerable amplification of the Chief's statement but still do not set priorities among uses and objectives. Regarding planning to achieve the Chief's Objective 1, the regional direction (A1-4) states, "Organize the forest as the planning unit and the district as the execution unit." (A1-6) states, "Identify planning units throughout each forest. Develop specific management prescriptions or guidance for each unit." Relating to the Chief's Objective 2, the key regional directions regarding quality management are: (B2-1) "In case of a conflict between quantity and quality, resolve in favor of quality," and (B2-2) "Quantity goals set at any given level of financing will meet quality standards."

At the Flathead National Forest, the introduction to the Basic Land Management Plan states the Forest Objective as:

> "The Flathead's mission is to recognize these unique situations (previously described resource and use situations) and manage the Forest in such a manner so as to provide proper balance between economics, quality of the environment, and social well being. management programs must also consider an appropriate mix of national, regional, state and local interests."

The Forest also envisions the development of a land ethic which preserves natural values and serves as a continuing constraint on management activity. Six statements are given to characeterize this land ethic which is summarized,"...

our basic land ethic should encompass a management philosophy that will keep the basic forest characteristics of the Flathead intact."

In the Guidelines for Unit Plans, the objectives of management are given more specifically through the recognition of "multi-objectives" for unit planning (page 8) which were extracted from the President's Water Resources Council:

1. To enhance National Economic Development (NED).
2. To enhance Regional Development (RD).
3. To enhance the Quality of the Environment (EQ).

Further, "no one multi-objective has any inherently greater claim on land and water use than any other."

In summary, all three levels of objective formulation seem to be reasonably well in agreement.

Generally, the objectives are to maximize national and regional economic and social welfare subject to preservation and non-degradation of the resource base. Considerable elaboration has been given to what the constraint "preservation and non-degradation of the resource base" means, but exactly what "national and regional development" implies has not been fully clarified.

The setting of objectives is at best a difficult and a continuing process. Clearly, the staff of the Flathead National Forest is giving the process diligent and honest effort. It appears the general framework and philosophy of management is well on its way. However, the guiding objectives are still too general to be of much help in choosing among alternatives. Consequently, inherent conflicts between objectives (regional vs. national demands) have not been resolved. As land management becomes more intensive

these conflicts become more apparent and more serious.

Although the distinction between objectives and constraints is reasonably clear in the national and regional directives, there still seems to be some confusion of the two on the Flathead. Specifically, the directives which are designed to protect the resource base are essentially constraints within which management must operate in its production of goods and services. However, in many of the popular utterances and in discussions with the Flathead staff, we sensed a belief that if all the environmental constraints were observed, these alone would determine an optimum management plan. This is not necessarily so and management cannot abdicate its function in favor of environmental determinism. The addition of constraints simply narrows the range of acceptable alternatives, but hard choices still have to be made among alternatives. The Forest may be viewed as a natural "factory" producing a flow of goods and service over time. Within the constraints of a quality environment the managers must still decide on what mix of products and services is to be produced and at what rate each output will be supplied in the future.

The need for specific objectives and for a distinction between objectives and constraints becomes particularly important in considering the future plans for production of timber from the Flathead. In the proposed allowable cut revision, the stratificiation of the land base into standard, special, marginal and deferred land and the imposition of restrictions on logging both reflect the addition of environmental constraints. Given these restrictions, there are still alternative possibilities for timber harvest from each land category and a choice must be made. On what basis will that choice be made? In the 1969 Timber Management Plan (pp. 33-37) three general

criteria, although not sharply stated, were used to choose among timber supply alternatives:

1. The Nation's pressing need for wood.
2. Reduction of the substantial insect and disease losses of high-risk mature stands.
3. Stable income and employment for the local economy.

Although not well defined it is assumed that the 1969 Timber Management Plan was prepared within the framework of the multiple use plan and thus did recognize multiple use constraints. In the written material and in the discussions reviewing the various timber supply alternatives produced by the RAM programs for the proposed new allowable cut we found no similar statement of objectives and criteria nor any other specific basis for choice among the alternative harvest schedules. The Forest has indicated that the three objectives noted above are still in effect and that others will be added.

Competence and Credibility of the Managers

The Flathead National Forest has taken several significant steps to improve the competence and increase the credibility of its staff. Most noteworthy is the new administrative organization which does away with the traditional staff structure and shifts to planning and concentration of technical expertise in a team effort. The Forest has opted to add professionally trained soils, hydrologic, fisheries and wildlife, and planning specialists to the staff rather than increasing its complement of general administrators. This change, coupled with diligent efforts to contact and work with the public and a true willingness to listen should result in better public acceptance.

Calculation and Analysis of Timber Productsion

Allowable Cut vs. Programmed Sell

These two fundamentally different concepts inevitably become confused. Allowable cut, as the term is presently defined and used by the Forest Service means the maximum amount of timber which could be sold from a given land area given assumed levels of management intensity and assumed requirements for stability of the cut from year to year. It is clearly a physical maximum concept, given a particular set of assumptions. It can be considered the answer to the question, given "X" amount of timber management funding, how much timber could be sold on a sustained basis over time? Programmed sell (sometimes called programmed cut) on the other hand, is the amount of timber that will actually be sold. The additional restraints of actual funds and manpower available to prepare and supervise sales and the actual standards of quality to be used in sale administration are imposed. Typically, programmed sell will be less than allowable cut.

The regional directives to place environmental quality over quantity considerations have increased unit costs of sale administration. This, along with little or no increase in budget, has necessarily limited the ability of the Flathead National Forest to place timber on the market. One cost comparison between two comparably sized sales in the Talley Lake district showed that sale preparation costs had risen from .006 man days/MBF in 1968 to .0096 man days/MBF in 1971 due to the imposition of the new environmental constraints. Being careful and ensuring quality is more expensive and will become even more so as additional constraints for quality management are imposed.

The distinction between allowable cut and programmed sell is apparently

clear to the Flathead staff. Supervisor Corpe in a letter of October 12, 1971 to the Regional Forester describing the five-year timber and road plans explained that "full cut" was envisioned at 182 MMBF while the "programmed sell" was 127 MMBF. The fiscal 1973 budget plan of the Flathead National Forest, despite nearly full funding of the timber program, proposed a programmed sell of only 119 MMBF.

The distinction between these terms is apparently not clear to industry, politicians, and the public. The Forest should be clearly saying "If we had a budget of X dollars we could produce and sell Y amount of timber. However, we only have W dollars and can only deliver Z amounts of timber to the market at present. If more is wanted then we need more funding." This sort of message doesn't seem to be coming across well.

We see no fault in the present rationale for a reduced programmed sell and given the facts on the costs of both sale administration and environmental constraints we doubt that the local economic community would either. The discussions that follow below are directed at the determination of the allowable cut for the Flathead National Forest, not the programmed sell.

A Comparison of the 1969 Allowable Cut and the 1972 Proposed Revision

The 1969 Timber Management Plan concluded that an allowable cut of 194 MMBF could be sustained from the Flathead. Shortly thereafter that figure was reduced to 182 MMBF when an area on the Middle Fork of the Flathead River was placed under a cutting moratorium during considerations for its addition to the Bob Marshall Wilderness Area. The 194 MMBF cut level was calculated from a commercial forest land base of 1,118,600 acres.

Following the change in planning methodology and a reconsideration

of environmental constraints on timber production, this timber growing land base was re-calculated as follows:

Commercial Forest Land - 1972
(in acres)

Areas deferred (moratorium from logging for consideration as wilderness areas	96,276
Areas classed as marginal for logging (can be logged only with restricted technology)	203,780
Special zones	46,240
Standard commercial forest land	692,319
Total of above figures	1,038,615
Total (from 1969 plan)	1,118,600
Difference in timber growing land base	79,985

Given this change in the timber producing land base and with some assumptions which will be discussed later, a change in allowable cut to a level of about 128 MMBF on the 692 M acres of standard commercial forest was suggested. An additional 31 MMBF from the marginal areas was recommended for classification as available when the necessary logging technology is developed.

Local Economic Impact of the Proposed Changes in Allowable Cut

The drop in cut from the 1969 level to the proposed level would definitely have a substantial impact on the Flathead and Lake County, Montana economies A rough draft of an Environmental Impact statement for the Flathead timber management plan estimates these impacts in Table 1.

These data were calculated directly from 1970 Bureau of Census figures and through the use of economic impact multipliers developed in Maxine Johnson's

excellent study and publication, "Wood Products in Montana" (Montana Business Quarterly, Spring 1972, Bureau of Business and Economic Research, University of Montana, Missoula). Given her assumptions, the estimates appear sound and the best that could be made without extensive additional study. The conclusions, however, do not seem to be presently applicable in that the impacts were calculated from a cutting base of 201 MMBF (source of that particular figure is unknown to the study team). The 1969 plan, adjusted for deferred areas, envisioned a sustained cut of only 182 MMBF. This figure seems to us to be the proper basis for comparison. Using the 182 MMBF figure as a base, the estimates of impacts are as shown in Table 2 (using the same multipliers as before).

If the 1972 proposed plan were adopted the immediate drop in allowable cut level would be to 123.7 MMBF from standard and special lands. This is also approximately the level indicated by the programmed sell. The drop in employment of from 300 to 600 (the industry's estimates run somewhat higher) would be about 3 to 7 percent of the industry employed work force of Flathead County. If logging technology is improved to the point where marginal lands could be harvested, the cut could rise to the 140-150 MMBF level.

This, then, is the proposed change in timber harvest levels over the next decade and this is the probable impact it would have on the Flathead County economy. The conclusion must be drawn that a change of such magnitude would have a substantial impact on the local economy. If maintenance or stability of the local economy is one of the Forest Service objectives, then such a decision warrants extremely thorough consideration and a search for alternatives with lesser impact.

Table 1. Impact of alternative reductions in allowable cut (from a level of 201 MMBF) on income and employment of Flathead County, Montana

Cut Level (million board feet)		Reduction in Employment (number employed)		Personal Income (millions of dollars)		Production in County Tax Revenues (thousands of dollars)
		Timber Industry	All County	Timber Industry	All County	
Present Level	201.0	-	-	-	-	-
Standard lands	116.3	-426	-(650 to 1184)	-3.2	-(5.3 to 10.5)	-559
Standard & special lands	123.6	-390	-(590 to 1084)	-2.9	-(4.9 to 9.6)	-511
Standard, special & marginal lands	155.6	-230	-(351 to 639)	-1.7	-(2.9 to 5.6)	-301
Total	171	-153	-(234 to 475)	-1.5	-(1.9 to 3.8)	-200

Table 2. Impact of alternative reductions in allowable cut (from a level of 182 MMBF) on income and employment in Flathead County, Montana

Cut Level (million board feet)		Reduction in Employment (number employed)		Reduction in Personal Income (millions of dollars)		Production in County Tax Revenues (thousands of dollars)
		Timber Industry	All County	Timber Industry	All County	
Present AAC	182.0					
Standard & special lands	123.6	-292	-(447 to 812)	-2.2	-(3.7 to 7.2)	-383
Standard, special & marginal	155.6	-132	-(201 to 367)	-1.0	-(1.7 to 3.3)	-173

Environmental Impacts of Proposed Changes in Allowable Cut

In the course of our visits we sensed an underlying feeling that a reduction in the allowable cut on the Flathead National Forest could automatically be equated with an improvement in environmental quality. Depending upon one's definition of environmental quality, this might indeed occur in parts of the forest, particularly those withdrawn from the general forest category. Reducing the allowable cut does not guarantee protection of environmental quality on those lands not withdrawn. For example, where water quality is concerned controlling the manner in which timber is harvested may be more important than reducing volume removed. Environmental quality considerations are more specifically related to controlling specific management practices on the ground than to a reduction in allowable cut.

Mill capacity in the Flathead Valley currently is estimated at 312 million board feet annually. About 61 percent (187 MBF) of this capacity is derived from national forest timber while industrial and small private lands contribute 23 percent, Indian lands 10 percent and the State Forest 6 percent. Interviews with industrial foresters and State Forest Service personnel indicate that these forest lands are currently either being cut at maximum capacity or are being overcut. (Latter three categories.)

The present maximum allowable cut on Montana State Forest lands is 35 million board feet. Some 25 million board feet come from Flathead, Lincoln and Lake counties. Of this 25 million, 18 million board feet are being cut on three state forests located within the administrative boundaries of the Flathead National Forest. It appears that environmental constraints relative to timber harvest on State Forest lands are being imposed by the State of Montana.

Local opinion, including that of the State Forest Service, expressed concern that if there is a substantial decrease in the timber harvest from the Flathead National Forest there would indeed be increased pressure to further overcut on all other forest lands. Such overcutting in and adjacent to the national forest would be deterimental from the standpoint of environmental quality, timber productivity and the long range economic climate.

At the same time that a reduction in the allowable cut is proposed, the forest is undergoing a marked transition away from clearcutting to partial cutting methods. This implies that more acres will need to be cut in any one year to attain even the reduced allowable cut. Moreover, it is likely that more roads will be required in a shorter time span to harvest this timber (not necessarily more roads in total).

A Detailed Review of the 1972 Revised Allowable Cut Calculations

Allowable cut calculations start with a current description of the commercial forest land; its acreage distribution by age and volume. Assumptions are then made regarding the intensity of forest management (pre-commercial and commercial thinning) and future rates of growth are estimated for existing and regenerated stands. A calculation is then made to determine what different rates of cutting or schedules of timber harvesting are possible over time. These calculations have grown increasingly sophisticated. A decade ago only a simple formula was used and a single constant level of cut was determined for the whole regulatory period (generally a rotation). The 1969 Flathead Plan broke this tradition by developing a series of physically possible timber harvest schedules which varied in accordance with the period selected for cutting over-mature sawtimber. With some 40 percent of the forest in these stands, conversion periods from 25 to 40 years were examined. Obviously, the rate of cutting has a substantial impact on the

amount cut over the first few decades. To illustrate, a 25 year liquidation period implied an annual cut of 241 MMBF, and a 40 year period a cut of 140 MMBF. A choice of 32 years was finally made which was the harvest schedule that provided the most stable projected flow of timber over the next 100 years. This schedule forecast a drop from 170 MMBF during the first 32 years to 155 MMBF in the fourth through the seventh decade. It indicated a rise to 183 MMBF by the end of the conversion period. This plan, however, proposed to fill the projected difference between 170 and 155 MMBF with commercial thinning volumes (Figure 1).

In the 1972 allowable cut calculations, the Timber RAM (Resource Allocation Model) computer program was used to simulate the timber supply schedules possible from the newly revised land base. Timber RAM is an approach for partially formulating resource management decisions by means of linear programming techniques which maximize combination of the outputs. The data derived for the Flathead Forest is given only by decades. It however can be revised at any point in time. Any change that would significantly affect timber harvest could be considered at the time it occurs. The RAM technique allows much greater sophistication in the specification of managerial constraints and timber management assumptions. Conversely, the solutions produced can be quite sensitive to the constraints and objectives imposed.

As inputs to the RAM program, Flathead management made several basic changes:

1. The available land base was changed as described earlier in this paper.

THIRTY-TWO YEAR CONVERSION OF MATURE HIGH RISK STANDS

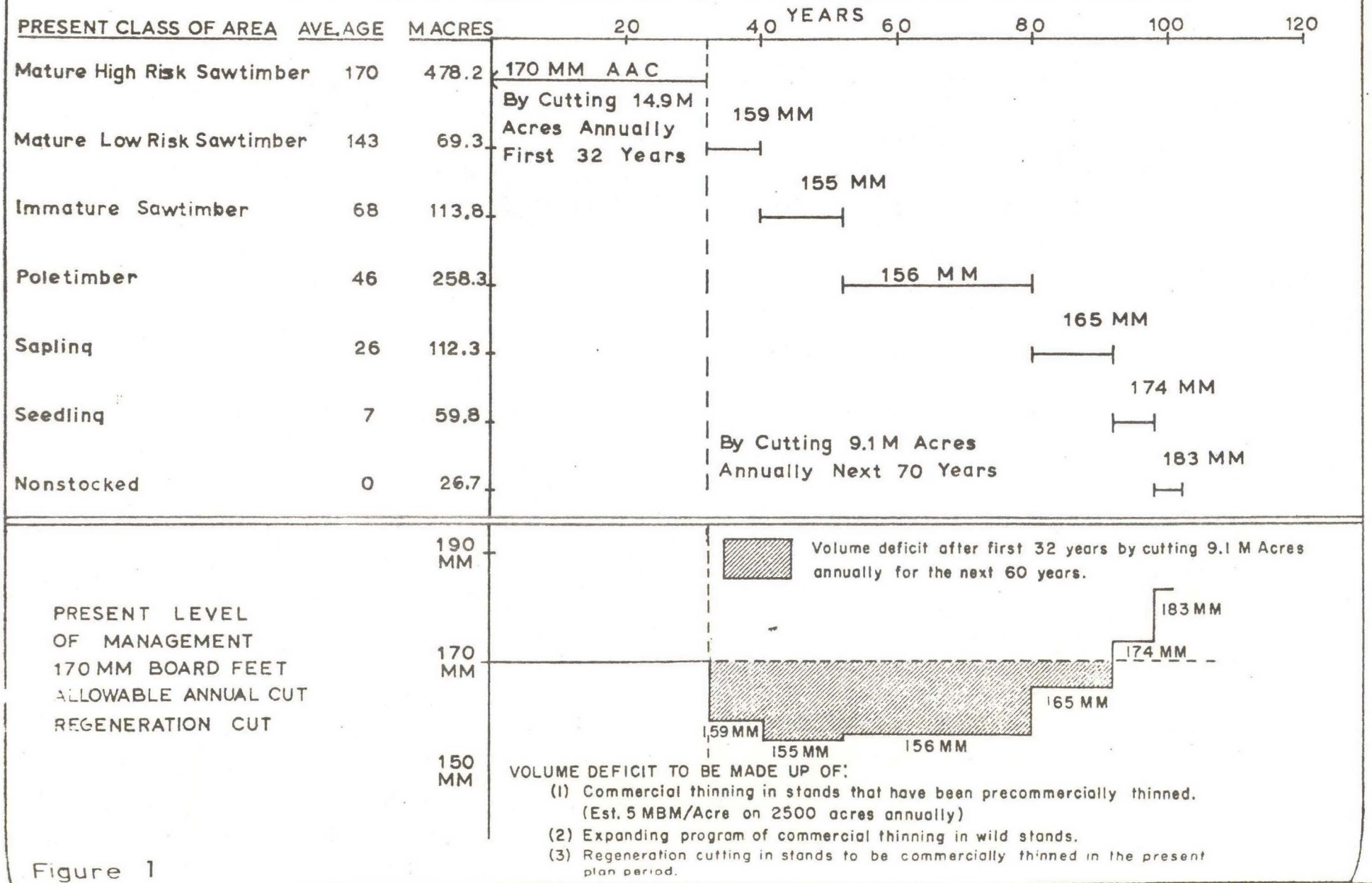


Figure 1

2. The conversion period of old growth sawtimber was changed from 32 to 50 years.

3. The growth assumption of regenerated stands was an average of 52.6 M/rotation (footnote 2, page 20, 1969 plan). It was 40.2 M/rotation in Timbram Matrix report #7, computer printout of run F-16. Time span or rotation was 101 years in the 1969 plan. The revisions in 1972 used a 90-year rotation.

4. The constraints on fluctuation of cut over time were drastically changed to allow a large drop in cut from the present level the first decade (50%) followed by a requirement for rigid even flow over the next seven decades (no change greater than -0.1% from decade to decade).

Running the program to maximize the total timber cut including thinnings, overwood and final harvest in the first decade resulted in a schedule of timber yields for standard, special and marginal lands (run F-16) that was 143 MMBF the first four decades. It rose to over 350 MMBF by the seventh decade and to more than 420 MMBF of sustained yield beyond the first rotation. (Numerous other computer runs were made with different assumptions, but this seemed the most relevant run to management.)

A graphical comparison of the pre-1969, the 1969-72, and the 1972 RAM supply schedules is shown in Figure 2. A summary of programmed sell, actual sell, actual cut and allowable cut is shown in Table 3.

The four assumptions used for the 1972 calculation were examined by the Study Team.

1. Revision of Land Base into Standard, Special, Marginal and Deferred Categories.

   Careful review of the written material and some field inspection by the Study Team led to the conclusion that the categories were sound. The change was simply the result of imposing some long overdue environmental constraints on the timber management program.

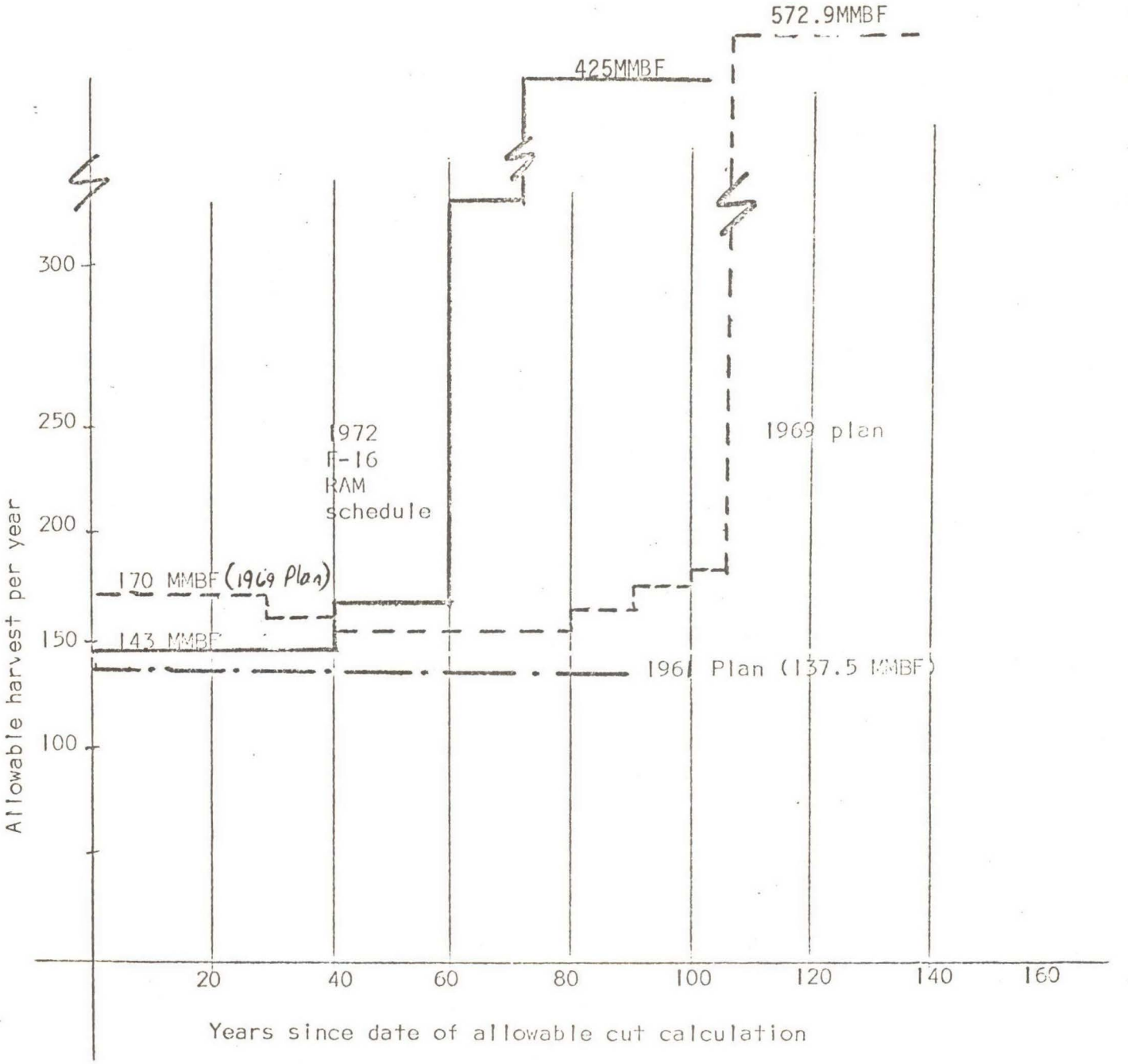


Figure 2. Allowable timber harvest.
Schedules from the Flathead National Forest.

Table 3. Cut and Sell on the Flathead National Forest, FY1964 to FY1973 in MMBF.

Fiscal Year	Programmed Sell	Actual Sell	Actual Cut	Allowable Cut
1964	136	135	136	137.5
1965	131	134	146	137.5
1966	135	138	168	137.5
1967	147	142	138	137.5
1968	141	147	156	137.5
1969	179	151	168	137.5
1970	199	232	146	194
1971	206	154	149	181.6
1972	127	132	156	181.6
1973	119	-	-	-

2. Change in Old Growth Conversion Period.

Initially the Study Team assumed that the primary basis for this change was dictated on hydrologic bases as inferred from the Flathead Forest Fact Sheet (page 6) and early discussions with the Forest staff. Subsequent analysis and discussion, however, indicated that the change in the old growth conversion period was in fact due to a combination of factors. Projected road development, landscape management, and even-flow constraints as well as hydrologic considerations entered into this decision.

The Study Team visited Hay Creek in the North Fork of the Flathead drainage to observe hydrologic impacts of logging. On the basis of the percent of area cutover in this subdrainage we were unable to note damage due to timber removal per se. However, the logging operation on Hay Creek had been poorly executed and local road and streambank erosion was evident caused by logging up to and across the stream. The Study Team assumes that these practices would be prohibited in any future harvest operations. It is also assumed that timbered strips would be left along water courses in any future harvest operation to mitigate bank damage and water quality problems.

Based upon field observation on Hay Creek and aerial flights over the North Fork it would appear that future timber harvests in the North Fork could be deferred until the present cutover areas have

fully regenerated and recovered. Research from other areas can provide clues to recovery time; however, the lack of observational and hydrologic data for the North Fork subdrainages and the recognition of their importance for west slope cutthroat spawning indicate caution and special treatment.

Conversely, however, an analysis using maps of old growth timber stands suggests that large volumes of remaining old growth timber is not located in such potentially sensitive areas. A rough approximation from Forest Service maps indicates that between 60 and 70 percent of the Forest's old growth timber lies in the Tally Lake, Condon, and Swan Lake Districts. On the ground inspections of these districts indicate much greater stability as well as much more rapid recovery rates. From a hydrologic standpoint at least, a conversion period significantly shorter than 50 years seems appropriate for much of the remaining old growth timber.

A closer examination of the RAM model reveals that a conversion period change from 32 to 50 years cannot be explicitly imposed as a constraint. Although old growth is entered as being available for five decades, the program could still, other constraints permitting, cut all the old growth in the first decade if it helped maximize the objective function. In run F-16, for example, Timbram Matrix report #6 does not even specify a minimum number of cuts to be taken. However, as the solutions to runs F-14 through F-17 all showed the old growth harvest to be spread over the first five decades, the change in conversion period was apparently accomplished in fact. The most

likely explanation of this is that the harvest control constraints were set sufficiently rigid to force such a solution. But the harvest control constraints are presumably set independently on the basis of the Forest's even flow policy. Some additional runs of the RAM program under different assumptions would be helpful to clarify this point.

3. Growth Rate of Regenerated Stands.

   This change probably did not affect the RAM projections significantly except to reduce the estimate of yield after all stands were cut and regenerated (beyond year 2060). This change was apparently considered unimportant or overlooked by the Flathead staff because the Fact Sheet stated that the "same measurements, volume tables and growth projections (from the 1969 plan) were used."

4. Change in Restrictions on the Fluctuation of Harvests Over Time.

   These restrictions have a significant influence on the solution to the RAM problems. The Study Team could not quantitatively determine the magnitude of this influence without running a series of problems on RAM using the same data but relaxing the harvest constraints. The Team does, however, raise the question of why these particular even-flow constraints are chosen. The 1972 even-flow constraints are considerably more rigid than those imposed on the 1969 plan. Somehow it seems curious that a large drop (50%) in cut is allowed from the current cut to the first decade but even flow is rigidly (no drop larger than .1%) adhered to thereafter.

Why is a large reduction in timber supply at this time any more or less acceptable than in the future? The Team suggests that alternatives with gradual reductions might be more meaningful and practical and less costly to the economy. It is important that these constraints be discussed and fully understood by the public because although technical in nature they effectively reflect the Forest's policy toward even flow and maintenance or stabilization of the local timber economy and toward national wood supply.

A variety of timber supply schedules could be generated with different harvest control assumptions. It would seem the appropriate question should be, "Given the objectives of the Forest, which of all the physically possible timber supply schedules would be the best?" This puts the issue squarely up to specifying the Forest objectives. It focuses on outputs (alternative timber supply schedules) rather than on inputs.

Since we are dealing with schedules (all of which will fluctuate), the traditional notion of "even-flow" does not seem particularly relevant as a constraint. It is important that the Forest stay productive in the general sustained yield sense, but just because the yield rises and falls over time does not mean that the land is not productive or that society's interest is not being served.

Multiple Use Considerations

Recreation

The Flathead Forest is unusually well-endowed with recreation resources and potentials. The entire area is blessed with a multitude of streams and lakes which provide a habitat for a wide variety of fisheries opportunities. Similarly, there is an excellent wildlife resource which is based largely upon what appears to be relatively stable populations of grizzly and black bear, mountain sheep, mountain goat, moose, elk and deer. The scenic quality of the mountains surrounding the Flathead Valley would rate oustanding by any yardstick. These mountains, lakes and reservoirs combine to provide an unusually attractive recreational environment.

The area around Flathead Lake is already well developed for both public and private recreation. Hungry Horse Reservoir on the other hand, is relatively undeveloped. Road counter data for the Hungry Horse Reservoir, however, shows 100,000 vehicle trips per year, an estimated 32,000 of which are associated with recreation. Angler days recorded on this "likely use" area for 1968 indicate over 5,000 angler days between May 1 and November 1. In addition to these two large lakes, there are many others both in public and in private ownership. In comparison with similar areas nationally, there is only low to moderate development around most of these. Generally, a short cool summer season and relatively cold water restrict swimming. Boating, water skiing, fishing and aesthetic qualities are rated high. The many rivers and streams also provide excellent fishing and river floating. Most of the lakes in the valleys are excellent trout water with some suited for warm water fisheries. The streams and higher lakes are largely trout waters.

A large proportion of the Flathead Forest has already been set aside for protection of the wilderness resource and for specialized recreational use.

The Bob Marshall Wilderness Area, the Mission Mountains Primitive Area (a wilderness candidate) and the Jewel Basin Hiking Area, all lie within the boundaries of the forest.

The Bob Marshall Wilderness Area covers about one-third of the forest (800,000 acres), and the Forest includes almost 8 percent of the total land in the wilderness system (1971). Use in the Bob Marshall has increased, at least in some drainages, to the point that restrictions on horse use and the closure of some over-used campsites has become necessary.

In addition, other large acreages of the Forest have been withdrawn in special areas largely for recreational use. The Forest has further identified four roadless areas which they judge meet the standards for additional wilderness. Development of a large area in the southern part of the forest is being delayed, pending a decision on a wild river status designation. The Forest is bounded on the northeast by Glacier National Park and gets a fair amount of use (particularly travel use) by visitors to the Park.

The area too provides for excellent hunting, both with guns and cameras for a wide variety of game and non-game species. All these opportunities provide an excellent setting for dude ranching, guiding, packing and outfitting opportunity.

On the Flathead as well as nationally, recreation and conservation groups have objected to the practice of clearcutting and to its impact upon the visual environment. The large amounts of slash and debris resulting from harvest operations, particularly in the old growth stands with large amounts of over-mature and unmerchantable timber have been the cause of criticism of Forest Service Management. The dense network of roads and often road location is questioned by some groups of recreationists as being undesirable, unnecessary and detrimental to wildlife.

In response to this criticism, the Forest Service has embarked upon a quality management program which will undoubtedly provide better aesthetic management in future timber harvest operations. Clearcutting practices, for example, are expected to be substantially reduced and additional restrictions will be placed upon road density location and maintenance.

Conversely, local business interests, local government and the forest industries are greatly concerned about what they believe is an unduly large percentage of this high timber producing forest being "zoned" into a restrictive recreational use (wilderness and other roadless categories). The timber industry is attempting to respond to a national need for more wood (a renewable resource) for much needed housing in the United States, and must rely heavily upon national forest timber to meet this need.

Among the various recreation interest groups, there appears to be mixed feelings on land use allocation. Perhaps the most rapidly growing segment of recreation is that which involves an increasing variety of wheeled campers, mobile homes and offroad vehicles such as motorbikes and snowmobiles. These recreationists, along with downhill and cross-country skiers, are currently beginning to ask questions as to what public (Forest Service) land will be left for them. It appears quite possible that if large withdrawals of public land for wilderness classification continue, there could be a major conflict of interest confrontation between recreation users themselves.

On the Flathead, current recreation development and use is relatively modest in scope. There are unusual potentials for future recreational developments. Probably the biggest deterrents to such development are the long distances from population centers to the Flathead Forest and the short, cool and often wet summers.

Fish and Wildlife

In the Flathead National Forest we are primarily concerned with a species of fish--westslope cutthroat trout--that has evolved over the centuries in a habitat of cold, clear streams where food production is very low. Their survival in this association of riffles and pools and periods of high water with a low silt load running off forested mountainsides indicate they are the species best suited to this environment. Obviously, man's activities in some watersheds are adversely affecting their survival as they are now classified as an endangered species. Another species, the Dolly Varden, uses these same streams for fall spawning. Their annual migration from Flathead Lake could also be adversely affected, either by stream blocks from excessive logging debris, or from the effect of increased silt loads on eggs and fry. The rate and manner in which we alter their aquatic environment could preclude any possibility of natural selection producing a cutthroat or Dolly Varden trout capable of surviving.

Data from fish traps and fish scale analyses indicate 60 to 70 percent of the cutthroat and Dolly Varden trout stay in the nursery streams where they are spawned for two years plus before descending to larger lakes or streams. Adverse impacts on unstable stream bottoms moving bed load in addition to silt not only may destroy the fish eggs or fry but destroy the whole food chain and thus destroy all ages of fish. In addition to 125,000 acres of Flathead Lake and its tributary system, and 12,000 acres of other lakes there are hundreds of miles of streams that are intimately interwoven so that a loss of one part means a significant loss in all parts of that ecosystem. The lake fisheries would essentially collapse with any significant loss of the productivity of the nursery streams.

Wildlife in general seems to react to the activities associated with logging in a variety of ways. There is apparently a difference in reaction by species and also in the reactions of individuals or groups within each species. Generally, the movements of elk, grizzly bear, mountain goat, mountain lion, lynx, and wolverine away from the noise associated with logging and road building seem to be more immediate and pronounced. Mule deer, white-tailed deer, game birds, black bear, bobcats, coyotes, and most furbearers apparently accept man's activities without moving far from their established home ranges.

Base-line data necessary to evaluate these movements are either non-existent or fragmentary. Long-range forest planning could probably have avoided some of the problems that now exist. In the future, when an area is to be logged, planning should provide for at least two contiguous drainages - more if possible - to be closed to all logging, vehicular hunting or sight-seeing, snowmobiling, or other human activities that would disrupt the movements of affected wildlife species. Such areas could be closed to hunting where winter range is adequate and an annual harvest is not necessary for species survival.

Hunters make up a large part of the complaining public. They see new areas being opened up and they naturally conclude that this will mean a reduction in all game species. Conversely, they would look on closures as automatic benefactors of game animals and fish, just as they now view wilderness areas in this light. Actually, except for mountain goat and grizzly, wilderness areas as they are now managed, are not necessarily optimum wildlife habitats. In fact, areas as large as the Bob Marshall Wilderness are virtually unmanageable from a game manager's viewpoint--at least under present regulations. Deteriorating winter ranges of elk, deer, and mountain goat are becoming

increasingly evident, but restrictions prohibit the employment of any practical tools to measure and control the decline.

Watershed Management

Erosion and Slope Stability

An inspection of timber harvest sites on the Tally Lake, Swan Lake and much of the Hungry Horse Districts revealed a conspicuous lack of erosion. The Study Team's visits followed the melting of a near record snowpack during the winter of 1971-72. The potential for flooding, and consequent erosion damage, exceeded even that of the 1894 and 1964 floods (Limpert - personal communication). The apparent stability of the area is due to the very high infiltration rates of the soils and to a precipitation regime which is conducive to rapid regrowth of vegetation. Evidence of overland flow was observed only on greatly disturbed areas such as roads and skid trails.

In the North Fork District as indicated earlier, additional timber harvesting, at least as practiced in the past (particularly with regard to road construction) should probably be deferred until recovery is assured. While stream channel and stream bed conditions presently seem stable except where disturbed by heavy equipment, the area in general could be ripe for accelerated erosion if there is continued disturbance.

In the South Fork, Spotted Bear and parts of the Hungry Horse areas erosion principally from roads presents fisheries as well as watershed problems. Slides on both Hungry Horse roads are apparently frequent. Both the Alpha and Beta Creek roads washed out this past year. Special corrective measures should be applied where these road problems exist. The Forest should strive for road-building and maintenance methods that lead to minimal silt load in streams.

Slope instability, however, might well occur in parts of the Hungry Horse and Spotted Bear Districts southeast of Glacier Park where the bedrock is composed of shales and softer sandstones. There is some evidence of landslides in this area. Consequently timber harvest here by conventional methods would probably be most questionable from a geologic standpoint.

The Flathead Forest, using guidelines provided by the Regional Office, assumed that timber harvest anywhere in the forest increased peak flood runoff, and that this, in turn, increased erosion or degradation in the stream channels of logged watersheds. A review of pertinent literature and discussion of the problem with Forest Service scientists involved in snow hydrology research indicates the following. First, instantaneous peak flows, or the highest peak runoff from snow-melt events, would not be significantly increased by timber harvest alone. Second, a maximum increase of 10 percent might be expected in streamflow volume after clearcut harvesting about 30 percent of a watershed. This increase would be reflected largely in sustained high flows (i.e. during the total period of snow-melt runoff) rather than higher instantaneous peaks. The time for which streams remained high would increase by some unspecified amount. Based upon the information provided by Bodhaine and Thomas (1964), however,the magnitude of this change could be expected to vary widely between the western and eastern portions of the Forest.

What would be the impact of this increased volume of streamflow and peaks of longer duration on stream channels? The stability of a stream channel depends upon stream flow pattern, channel shape and slope, the

material which makes up the bed and bank, the vegetation along the bank, the debris in the channel and many other factors. Thus, streamflow is only one of a number of factors affecting stability. Given any increase in the duration of high flow, it is easy to see that the impact would vary widely from stream to stream or within different reaches of the same stream. An obvious example on the Flathead National Forest is the difference between the streams of the Glacier View District, where runoff is high and channels are steep, and the drainages of the Swan Lake District, where runoff is lower and,in many cases, no channels can be found in watersheds of several square miles. The Forest Service hydrologists already recognize this diversity--it is well described in their stream channel stability classification form (R-1-2500-5). Also, the ability of most channels to withstand deterioration from small increases in streamflow volumes should be quite high. We were impressed with the lack of bank cutting on most streams. This stability is due, in part, to the normally low fluctuation in water level characteristic of these streams, allowing the channel banks to maintain an equilibrium with streamflow. Emery Creek, as was noted earlier, shows a maximum fluctuation in flow from the summer low flow to the 1964 record flood of only about three feet, even though the drainage area is some 26 square miles (Simons 1964).

When determining constraints in allowable cut based on the probable impact of timber harvesting, the use of a series of values computed for like areas seems much more appropriate than the application of a single, forest-wide calculation.

Assessing channel damage is also likely to be difficult. How do you separate normal channel cutting from that caused by slightly increased peak flow volumes? How do you separate the effect of normal debris accumulation from that caused by possible increased flow? What is the long-term impact of major flood events? Or even more importantly how can an assessment be made of damage caused by poor harvesting methods which the Team assumes will no longer be tolerated? These are all very important questions yet all are presently nearly unanswerable. The Team feels that timber harvest in the North Fork drainages as exemplified in Hay Creek should be deferred until additional observations and data are available and until acceptable practices can be assured.

Hydrologic Recovery

The term "hydrologic recovery period" was used by Forest personnel to describe the period required for a logged watershed to return to prelogging levels of streamflow. At the end of this period, the forest canopy would be closed, roots would fully occupy the soil mantle, and evapotranspiration and interception of precipitation would be the same as before logging. The period given for hydrologic recovery was 50 years and coincides with the conversion period for old growth timber. Hydrologic recovery as related to full occupancy of the site by trees will undoubtedly vary widely on the Flathead. One site visited by the Team located west of Swan Lake seemed to have met the requirements for "recovery" in about 15 years. In addition the transition in future harvest operations away from clearcutting will tend to favorably influence recovery spans.

Logging and Water Quality

When considering the impact of logging on streams, it is also important to evaluate the effects of road construction and clearcutting on water quality characteristics such as water temperatures and suspended sediment concentration or turbidity. On the Flathead the issue is particularly critical since one of the key resource considerations is management of the west slope cutthroat trout, considered by some as an endangered species.

Clearcutting along streams in the Flathead National Forest can be expected to increase stream temperature. The amount of temperature change experienced will depend upon the length of stream exposed, the width of the stream, and its discharge or streamflow rate. Flathead Forest personnel have documented some rather large changes in water temperature as streams flowed through clearcuts. While some change in stream temperature will occur with exposure of any stream, the magnitude of the temperature change and its impact on fish production will vary from stream to stream. Again the move away from clearcutting practices and the more widespread use of forested buffer strips along water courses should be beneficial.

Increased sediment concentrations following road construction and logging is a problem in some parts of the forest, but the impact, again, is highly variable. The lack of overland flow in much of the area now classified as the general forest zone precludes the severe erosion and sedimentation associated with road construction and logging in other areas of the west. Roads, both mainline and spur roads servicing jammer-logged areas, continue to be the primary source of sediment. Forest personnel recognize this as a key problem. Again the Team assumes continuing and even closer compliance with environmental constraints on road location, construction and maintenance.

RECOMMENDATIONS

1. ALLOWABLE CUT REASSESSMENT

In view of the evaluations and suggestions indicated above the Team suggests the Forest reassess their allowable cut projections. As one specific suggestion on recalculation of the allowable cut using Timber RAM, it is suggested that the Forest be stratified not only by stand condition (as in the present calculation), but also by land zone (standard, marginal, etc.) and any substrata of hydrologically or otherwise sensitive areas. Restrictions on conversion periods, management intensity, access, utilization, technology, etc. could then be developed specifically for each of these strata. In terms of the RAM model, this would increase the number of land class entries from the present level of 9 to 40 or 50 but it would present a much more refined and realistic analysis of the actual situation on the Flathead.

In any RAM calculations, the harvest control constraints appear to have a dominant influence on the solution to any given problem or run. These constraints essentially reflect the forest policy toward "even-flow" of timber production over time and consequently the Forest's policy toward the local timber based economy. These constraints deserve much more thorough discussion and justification. This should include a discussion of the alternatives of spreading any needed reduction in harvest over a longer period. Timber RAM was developed to determine optimum harvest schedules using a linear programming solution technique which ordinarily makes it an optimizing model (i.e. choosing the "best" solution among many alternatives). However, Timber RAM was used

on the Flathead primarily as a simulation technique because the input assumptions are so limiting and the solution so constrained. Different assumptions regarding timber management intensity, access, harvest control, etc., would result in a variety of physically possible and environmentally practical timber yield schedules from the Flathead National Forest. This would greatly assist in the problem of choosing which timber yield schedule is "best." In making the choice, the Forest must clearly articulate its timber production objectives and establish criteria for choosing among alternative schedules.

Since it will be over a decade before the interdisciplinary planning process is completed for all 35 planning units, the allowable cut calculations should be viewed with considerable flexibility. As new information and technologies become available adjustments will frequently need to be made. The forest should avoid getting "locked in" or committed to any one allowable cut forecast.

The distinction between programmed sell and allowable cut must be clearly drawn and understood by industry, the community and the Forest Service. Alternative levels of both programmed sell and allowable cut which could be realized with different levels of financing should be specified. If the present level of programmed sell is considered to be too low in relation to local economy and national needs, the Forest Service should make it clear just what personnel and funds are required to achieve higher levels of cut consistent with environmental quality. The industry and the community can then share in the mutual responsibility for developing the needed manpower and resources (see U. S. Forest Service Manual FSM 2410 dated May 1972).

2. PLANNING METHODOLOGY

It is critical that the Flathead Forest develop some systematic procedures for coordinating unit planning efforts at the forest level. Unless such coordination is instituted, the total forest plan will simply be the sum of the numerous small plans. Since the Forest is the designated planning and decision-making unit, choices among alternative mixes of goods and services still must be made at the Forest level with the tradeoffs and balances made among the smaller unit plans.

Unit planning tends to emphasize land capability as the major determinant of management. At the same time the Forest as a whole must still provide a mix of goods and services that best meets the needs of the American people.

3. TIMBER SALE CONTRACTS AND ADMINISTRATION

The Team urges the consideration of some innovative timber sale contract and administration procedures on a trial basis on the Flathead National Forest.

It is apparent that until acceptable techniques and procedures are developed for harvesting timber on the marginal and special lands, and until decisions are made on the land areas currently being considered as wilderness candidates,wild river or other undeveloped areas, the annual timber harvest from the Flathead Forest will in fact, be considerably less than the allowable cut.

Further, as the Forest proceeds in its quality management program and as it complies with the directives of the National Environmental Policy Act, greater effort must be devoted to timber sale preparation, admini-

stration and supervision for any given level of allowable cut. To offset the anticipated shortage of funds and personnel we suggest that the forest industries assume more responsibility for quality management and for timber sale administration and control.

As a starting point and on a trial basis, we recommend that the Flathead Forest and the local forest industry cooperate in designing salvage, sanitation, and/or commercial thinning cuts in which the forest industry assumes a major role in sale supervision. Industry would be expected to employ an "environmental forester" who would work very closely with the Forest staff in assuring compliance with Forest Service determined environmental safeguards and standards on harvesting operations. Construction and maintenance of roads would be of paramount importance. Industry, through its environmental forester, would first police itself. Failure to comply with established standards or procedures would result in a substantial fine being imposed on the contractor. By placing any such fines in a fund that would be used for the mutual benefit of the timber industry, the stigma of a criminal act would be removed and the motivation to cooperate would be greatly enhanced. Repeated or gross failure should result in sale closure and forfeiture to the United States of any required bond. If entered into wholeheartedly by both, we believe such a procedure would reduce the environmental damage observed on some past sales. (See also recommendation on Operator Training below.) Adoption of a strict code of ethics would be a direct contribution to upgrading the images of the industry and of the profession.

If the forest industry can demonstrate its ability to police itself and make substantial progress toward quality management on our public lands,

the time formerly devoted to sale administration by Forest Service personnel can be substantially reduced and thus diverted to other quality management activities. Demonstrated success on a trial basis could lead to a broadened program and consequently to an increase in programmed sell. The Team believes that such innovative steps could result in improvement in environmental quality (needed salvage and sanitation cuts could be accomplished more rapidly and economically). More rapid conversion to intensive forest management would be possible under such a program.

4. OLD GROWTH CONVERSION

The Study Team recommends that consideration for the general forest be given to a reduction in the time period proposed for the removal of the old growth timber on the Flathead Forest (50 years). It is the consensus of the forestry profession that intensive management of old growth timber is at best difficult. In the case of the Flathead, there is an estimated annual loss of 18 million board feet to decadence in these old growth forests. There is greater opportunity for insect and disease infestation in mature and overmature stands. There is generally a much greater volume of available fuel which creates a higher fire hazard. Further, the old growth forests present much greater management problems with respect to volume of difficult to dispose of slash and debris. Often the old growth forest contains large areas of down timber which makes travel and access difficult for wildlife and recreationists alike.

The more rapidly such areas are harvested (consistent with other multiple use considerations) the earlier the Flathead Forest will be able to achieve

Intensive forest management and its stated longer range objective of a substantial increase in timber yield while enhancing the forest environment and non-timber uses.

The Team recognizes that old-growth forests have other values than industrial use and that even in the general forest zone it will be desirable to retain some such stands for aesthetic and for study purposes.

5. FOREST LAND CLASSIFICATION (Land Capability/Use/Classification)

It is recommended that decisions be reached as early as practical on the several proposed changes in forest land classifications under study or moratorium. Under such consideration are the Middle Fork 1970 moratorium lands, the Wild River candidate areas and four roadless areas, with wilderness potential. Although these areas were not examined in depth by the Team, the percentage of total area that could conceivably be classified as wilderness or undeveloped for other than wilderness type recreation seems disproportionately high for the Flathead. There is currently a large area of the Forest "in limbo." Many management decisions are dependent on the outcome of such classifications. These decisions will have a significant impact upon the planning of state and local government and the timber industry.

6. OPERATOR TRAINING

It is recommended that the forest industry in concert with the Forest Service initiate a series of training sessions for their woods working personnel and subcontractors. These sessions would consider environmental management objectives and methods. Representatives of conservation groups could be invited to participate in or observe such sessions.

It is evident that some of the past criticism leveled at the forest industry and the Forest Service regarding poor performance of harvesting operations is justified. Such practices as poor layout and design of cutting areas, logging up to stream channels, running logging equipment and dozers across streams, unnecessary soil movement and disturbances, both overload and overheight loading of log trucks and poor road maintenan ce are examples of practices that are correctable. Operators need to be apprised of the practices to which the public objects and of the penalties for failure to comply.

7. TIMBER UTILIZATION

Here is another opportunity for industry to exert a strong and positive influence on the management of the Flathead National Forest. Utilization of smaller logs allows forest managers to increase production on forest lands through thinnings, reduce the hazard of fire from larger harvest operations, to reduce the volume of slash, and to help relieve public concern over the aesthetic problems associated with slash accumulation. The development of markets for small material and the diversification necessary for processing should be an industry responsibility. The Forest Service, on the other hand, must provide the Flathead National Forest with sufficient manpower to administer such a program. Closer utilization of the timber resource is currently a high priority program throughout the Forest Service. The Flathead National Forest provides an excellent laboratory for implementing such a program.

8. WILDLIFE WINTER HABITAT CUTTINGS

The Study Team recommends that the Flathead Forest in cooperation with the Montana Department of Fish and Game initiate a program of identifying areas throughout the forest(excluding wilderness) where game animals are now wintering. Winter range is generally the primary factor controlling wildlife. Biologists indicate that game often are found wintering in low snowfall areas not normally considered to be big game wintering habitat. Such areas, locally referred to as "microclimates," are often only a few hundred acres in size in the lee or "snowshadow" of a higher mountain. Biologists are reasonably certain that many more areas than those presently known exist and believe that the wildlife habitat (winter range) could be measurably improved by selective cutting or controlled burning which would open up the canopy and promote the growth if browse plants.

Identification of such areas by both on the ground and aerial surveillance could readily lead to timber harvests designed primarily to improve winter range and enhance wildlife management. At the same time, they would make an added contribution to the annual harvest.

9. ROAD SYSTEMS PLANNING

It is recommended that a master road plan be developed for the Flathead Forest as early as possible and that the Forst Service seek new and more appropriate methods for financing the construction and maintenance of forest roads.

A master road plan indicating the projected future development of the Forest and showing classes of roads present and projected would be an

invaluable tool in planning. Such a plan should consider multiple use needs such as recreation access, forest protection and fish and wildlife considerations as well as timber harvest. The master plan should indicate the permanent multiple use road system as well as temporary roads which might be used for timber extraction.

Increased attention should be directed to the location, construction, maintenance and eventual abandonment of the temporary roads. The Forest should consider the need for logging techniques which require less dense roading, increased use of one-way haul roads which require less earth moving, the application (and enforcement) of better road maintenance practices, and specific abandonment and closure procedures. Temporary roads should be "put to bed" (surface scarification, drainage and seeding) as soon as they are no longer in use for timber extraction. In the Flathead Forest, particularly in the back country, road location and layout should be coordinated with the Montana Department of Fish and Game for wildlife management considerations.

The present system of financing roads on national forests does not appear to be appropriate to either quality management or multiple use management. The majority of new road construction cost is carried by timber sale contracts (decreasing the price paid by the contractor for standing timber). This practice has tended to put undue pressure on both the Forest Service and the contractor to get maximum income from the harvest operation to offset roading costs. The result has frequently been to concentrate the timber harvest operations on relatively small areas of the forest. As the road system is developed, the harvest can be more readily spread over the forest.

It is urged that the Forest Service seek new funding procedures and establish new policies for the construction of the primary road systems. It seems more appropriate for the timber sale contract to carry only that portion of the temporary road system construction related specifically to timber harvest. Appropriated funds and/or income derived from all uses should provide the primary road system.

Both the Forest Service in general and the Flathead Forest have announced policy decisions to reduce clearcutting practices and increase partial cutting. To reach the level of timber harvest set, it is apparent that the cut will have to be spread over a larger area and that more road construction will be required in a shorter time period (not necessarily a greater volume of roading in total).

10. TIMBER HARVEST ON MARGINAL AND SPECIAL LANDS

It is recommended that the Flathead timber industry immediately and aggressively enter into a partnership with the Forest Service to develop appropriate harvesting technologies for the marginal and special lands. We believe the major initiative and responsibility for this effort should be assumed by Industry. A variety of methods is available such as cable and balloon systems, but an investment of time and resources is needed to adapt them to the Flathead. Since the allowable cut is finally partitioned by land strata, Industry cannot expect the Forest to increase sales on standard lands to compensate for logging problems on the marginal lands. If Industry wants the additional volumes, then they must learn to log on marginal lands.

11. PERSONNEL STABILITY

It is recommended that present personnel promotion and transfer policies of the Forest Service be re-examined to determine if ways can be found to reduce the personnel turnover rate at the forest level. The cornerstone of any quality management program is the soundness of informed judgments by specialists and managers on the ground. Sensitivity to and extended personal experience with the local ecological, social and economic situation provides the best background for well-informed judgments. Hence, the greater the emphasis on quality management, the greater the inherent conflict with a personnel management program which fosters rapid turnover. Just as an example, if the Level I intensive unit planning effort is expected to take a decade to accomplish, it is quite possible that up to three complete sets of personnel will rotate through the Flathead Forest before that level is reached. Continuity, competence and consistency of the planning effort will be difficult to achieve under these conditions. In a new and innovative planning effott such as this, personnel should have the opportunity to live with their successes and to rectify their mistakes.

12. STREAMSIDE MANAGEMENT

Many of the water quality and fisheries problems associated with logging and road construction could be avoided by implementing a rigid streamside management program. Keeping machinery out of the channel and off channel banks, leaving trees and other vegetation to provide shade for the stream and to act as barriers for down-slope movement of slash, eliminating channel crossings, using bridges on perennial streams, and felling trees

parallel to or away from the stream will prevent many problems. Wider buffer strips along streams with selective logging in these strips to reduce blowdown and logging debris reaching the stream are suggested. Similarly bridges should replace the use of culverts in areas where fish passage is necessary for spawners to reach spawning beds. As early as possible poorly placed culverts should be replaced and logging debris should be cleaned up on high value spawning streams. Road placement, engineering and maintenance are highly significant factors in fisheries management. Alternative means of timber harvest should be considered where road problems cannot be overcome.

Enforcement of existing regulations has been lax in the past. Here is yet another instance in which Industry, too, can through cooperation significantly aid the Forest Service in doing a better job of resource management.

13. WILDLIFE MANAGEMENT CONSIDERATIONS

As additional timber harvesting operations are planned it is recommended that special attention be given to wildlife management problems. Size and location of cutting areas and access road use are of particular concern.

Relatively small and adequately dispersed cutting areas, including clear-cutting, are not considered detrimental to wildlife. Timber harvest operations on Sullivan Creek on the west side of the South Fork of the Flathead River provides an example of poor planning as far as wildlife management is concerned. Approximately five miles of this drainage is

unroaded. The rest is roaded and has been logged as are all contiguous drainages in a circle of 330 degrees. Observation in this area in 1971 indicated that a herd of elk, some goats, mule deer and both black and grizzly bear were holed up in this relatively small area away from the activities of man and vehicles.

If and when further timber sales are prepared for the Sullivan Creek area, it is recommended that roads present or planned in both the North and South Forks of Lost Creek be closed at least two or three miles below their present ending point. In addition, it is recommended that travel in Bunker Creek be restricted to the lower end. Addition Creek, Bruce Creek, Soldier Creek, Connor Creek, and Slide Creek should all be closed to motorized travel. The same guidelines would apply to a practical degree, when a new area is logged or when activities are continued in an area that has formerly been logged.

Management of these surrounding areas as de facto wilderness during periods of logging would enhance wildlife and multiple use management.

14. RESEARCH NEEDS

Inevitably, studies such as this generate more questions than can be readily answered. Although the Team did not consider research needs in detail, a number of obvious problems were apparent. It is suggested that the Forest, in cooperation with the Intermountain Forest & Range Experiment Station, the state universities in Montana, the state's natural resources agencies and Montana forest industries concentrate research efforts on some of the practical problems of forest management exemplified on the Flathead Forest. Some examples are:

1. Quantitative identification of streamflow increases, sediment production and channel damage associated with environmentally controlled logging operations and timber harvesting technology.
2. Development and/or adaptation of an acceptable timber harvesting technology capable of profitably logging marginal and sensitive forests.
3. Assessment of the total costs and benefits of environmental quality management including, if applicable, income foregone. (e.g., what does quality road construction and maintenance cost?)
4. Development of quality standards for environmental management (e.g., water quality, sediment, erosion, aesthetics tolerances).
5. Assessment of conditions under which no stumpage value or even a negative stumpage price (i.e., payment could be made to a timber operator for harvesting a problem area) might be justified to achieve an improvement in environmental quality.

CONCLUSION

The Study team is fully appreciative of the climate of change in which the Flathead Forest and the U. S. Forest Service are now operating. We are in agreement with both their professional desire and the agency mandate for quality management. We urge that the Forest continue its present efforts to inform and involve the public. The Forest Service has a tremendous pool of talent, including its own research staff, and we urge that it be fully utilized in the major decisions the agency is currently making in its management metamorphosis.

We recognize that some of the land use decisions which must be made at the Forest level are highly dependent upon regional and national policies, many of which are currently being reassessed. Clear definitions of environmental quality and objectives to meet established goals are badly needed. We urge that every consideration be given to a realistic balance between quality management and socio-economic needs. If national projections for timber demand are even close to being correct (a doubling of our present consumption in 28 years), major reductions in the allowable cut from heavy timber producing forests like the Flathead could in fact have a deleterious effect on both the physical and the economic environment - local and national.

The area's forest industries have been economically efficient in their harvest operations. This economic efficiency, in the past, usually with Forest Service concurrence and public apathy has unquestionably resulted in some environmental and ecological mistakes. The Team feels that industry, the Forest Service and the general public are all painfully aware of these mistakes. Both current public opinion and Forest Service policy

give a clear indication that we must indeed embark upon a quality management program. The cost of quality management at whatever level will inevitably be borne by the public. We have yet to assess these costs - economic and social. The Team is of the opinion that Industry both must be and is ready to accept reasonable environmental constraints.

The conservationists who justifiably have been highly critical of some of the past practices are at the same time beneficiaries of past economic efficiencies. They now are insisting upon a trade-off of economic efficiency for environmental protection and enhancement. The various conservation groups should recognize that forests are a renewable natural resource and that timber processing has low energy requirements for conversion to usable products. Substitute materials such as steel and aluminum are non-renewable and consume large amounts of an already critical energy supply in their conversion. To insist upon a nearly "pure" forest environment would require a trade-off wherein non-renewable natural resources would be expended and a substantially higher level of energy consumed with attendant environmental degradation problems.

A recent statement by T. F. McLintock (1972) of the U. S. Forest Service is particularly appropriate to and expresses well the Team's feelings toward the Flathead situation:

> "We must realize that a managed environment represents a compromise, a gray area. Virtually nothing is black or white. Air and water quality standards are not set to guarantee all citizens protection from a given hazard. Similarly, zero environmental impact from logging should be recognized as not only impractical but as ecologically impossible. On the other hand, continued application of timber harvesting and management systems solely on the basis of operational efficiency is equally unrealistic. Compromise and reconciliation are not cop-outs, as often charged by extremists of both sides; they are not a rationalization for moral disengagement. They simply constitute the only realistic course to pursue."

The Study Team feels that the Forest Service, the industry and the people of the Flathead Valley have the capacity to provide and enjoy both a healthy physical and economic forest environment. The Forest Service, with the cooperation of related agencies and of industry, now needs to take further steps in this direction. The public must also assess its priorities and will determine the ultimate levels of forest land management that will be achieved.

We hope this study will have value to the Flathead National Forest and to concerned citizens of the Flathead Valley in seeking solutions to a total quality environment.

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